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International Physical Medicine & Rehabilitation Journal

Utility of Electro-Tactile (Brain Port®) Stimulation in Vestibular Rehabilitation

Abstract

The Brain Port® device uses an electro-tactile stimulation of the tongue to transmits an artificial sensation of cephalic orientation in relation of the vertical plane. The cephalic position´s information (generated by the micro-electric mechanical system) is used as an input signal for the Brain Port device; with the data, the device generates a pattern of stimulation of the tongue that is related with the cephalic position in real time, so the patient learns to keep the stimulus centered in the middle of the matrix to get the proper posture.

Keywords: Vestibular rehabilitation; Vestibular hypofunction; Posturography

Case Report

Volume 1 Issue 1 - 2017

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Received: March 03, 2017 | **Published:** April 19, 2017

Introduction

Postural control represents a complex function in our bodies with the participation of visual, vestibular and proprioception information that later on is integrated in central nervous system [1]. The intervention and maintenance of anti gravitatory balance and the right answer in case of equilibrium disorders depends on the accuracy of these information and its proper integration.

When there is no vestibular system functional, central nervous system has problems to do a right integration from the other afferent systems: visual and proprioception [2].

Brain Port® is a device designed to represent quantitative and qualitative information of the tongue´s anterior surface by electric stimulus through a matrix of electrodes [3].

Head position data (artificially sensed by a micro-electro mechanical system (MEMS) accelerometer) serve as the input signals for the Brain Port® device.

The Brain Port® device has two principal components: the intraoral device (IOD) and the controller. The IOD is made up of an electrotactile array and a MEMS 3-Axis, ± 2 g, digital output accelerometer. Brain Port® device utilizes both the horizontal (x, y), and vertical (z) axes. A flexible tether connects the IOD to the controller. The MEMS accelerometer senses head position in both the anterior/posterior and medial/lateral directions and is mounted on the superior surface of the electrode array (away from the tongue). The accelerometer is encapsulated in a silicone material to ensure electrical isolation from the user.

The electrodes make an electro-tactile screen where the required information is represented in real time as a pattern or image with different levels of complexity.

The tongue´s surface (usually the anterior third- the most sensitive area) is a sensorial surface organized topographically in which a natural matrix of mechanoreceptors and nerves endings can read the contents of the screen, encode the information and then, transfer to the brain as a "tactile image"3. With a minimal training, the brain can decode these information in terms of spatial, temporal and cualitative characteristics and use them to satisfy the immediate needs.

Clinical Case

60 years old woman complains of postural disorder after neurosurgery of a meningioma of clivus and left cerebellopontine angle nine years ago with stereotactic radiotherapy five years ago. After clinical and classic posture graphic rehabilitation in several medical centers in Spain instability remains.

Clinical Exploration

right horizontal rotating nystagmus in right gaze and left nystagmus in left gaze. Instrumental exploration: left vestibular hypofunction not compensated in caloric tests and disturbance in parameters of the static posturography (Figure 1).

The patient was rehabilitated with Brain Port® in 20 minutes-daily sessions for three months in different positions: First, eyes closed, seated with the back relied on. Then, without support. After that, in standing position with the back relied on. Then, without support. And finally, all the exercises were repeated on a foam surface.

The patient improved the postural control after the therapy shown in the static posturography performed two months after the sessions end (Figure 2). The follow-up has been one year.

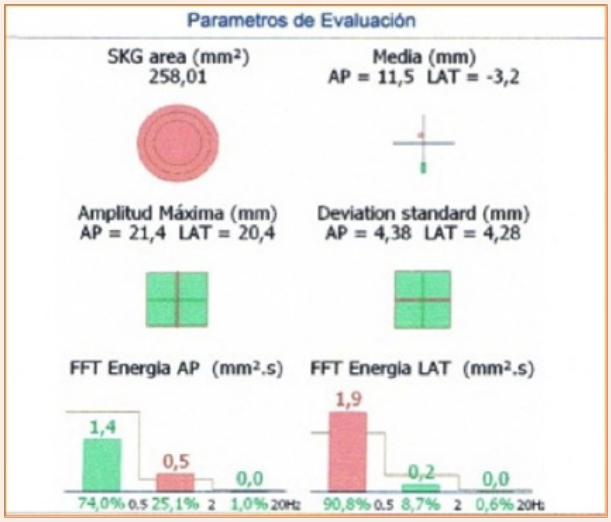

Figure 1: Static posturography pre-treatment.

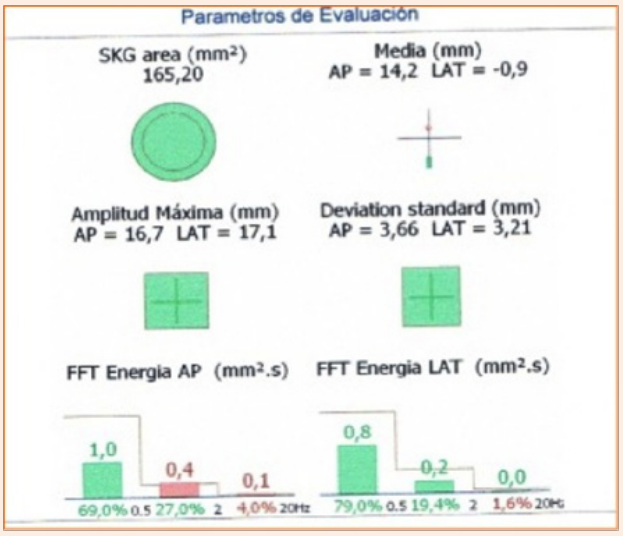

Figure 2: Static postuography post-treatment.

Discussion

The electro-tactile stimulation (Brain Port®) might be considered a supplementary option in the rehabilitation treatment in unilateral, bilateral vestibular diseases and also central diseases, especially in cases that have failed with conventional therapy.

Acknowledgements

To Pilar, our nurse who helped with the rehabilitation.

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Citation: Sáenz-Piñones JC, Arellano B and González FM (2017) Utility of Electro-Tactile (Brain Port®) Stimulation in Vestibular Rehabilitation. Int Phys Med Rehab J 1(1): 00004. DOI: 10.15406/ipmrj.2017.01.00004